

The ABCs of ABGs



Pramita Kuruvilla and Jessica Cohen
Intern ICU Course
June 2009



Course Outline and Objectives

- Introduction and review of arterial blood gas, metabolic/respiratory acidoses/alkaloses
- Rapid Interpretation of arterial blood gases
- Discussion of cases/clinical scenarios
- Understanding of the purpose of arterial blood gases in clinical settings.
- Discussion of therapeutic interventions



The ABG: Normal Values

■ pH	7.35-7.45
■ pCO ₂	35-45 mm Hg
■ pO ₂	80-100 mm Hg
■ HCO ₃ ⁻	22-28 mEq/L
■ Base Excess	-2-+2 mEq/L
■ sO ₂	94-100%
■ Patient Temp	37
■ Hemoglobin	14-18 G/DL



pH Abnormalities

- pH less than 7.35 → Acidosis
- pH greater than 7.45 → Alkalosis

- Causes can be metabolic or respiratory
- Need to see the pCO₂ and the HCO₃⁻ to determine the cause.



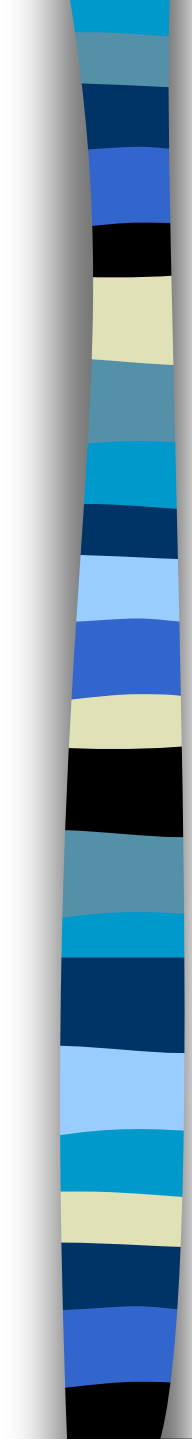
pCO₂ and HCO₃⁻ Abnormalities

- Respiratory acidosis → **high** pCO₂ (> 45)
 - *e.g. CO₂ narcosis, brain death*
- Respiratory alkalosis → **low** pCO₂ (< 35)
 - *e.g. hyperventilation*
- Metabolic acidosis → **low** HCO₃⁻ (<22)
 - *e.g. sepsis, DKA, alcoholic ketoacidosis*
- Metabolic alkalosis → **high** HCO₃⁻ (>28)
 - *e.g. vomiting, massive diuresis*



pO₂ and sO₂: Definitions

- pO₂ = PaO₂: arterial oxygen tension
 - *i.e. oxygen dissolved from alveoli into plasma*
- sO₂ = SaO₂: arterial oxygen saturation
 - *i.e. proportion of red blood cells whose hemoglobin is bound to oxygen*



Base Excess: a.k.a. the idiot's guide to rapidly interpreting ABGs prior to drinking coffee...

- Always **METABOLIC**

- If **positive number** → metabolic alkalosis

- If **negative number** → metabolic acidosis

- Significant if greater than 2



Strategies for Interpretation

- 1st: Look at the pH and the Base Excess and decide if it is acidosis, alkalosis, or both
- 2nd: Look at the pCO₂ and the HCO₃⁻ and decide if it is metabolic, respiratory, or both
- 3rd: Compensation present or not?
- 4th: Look at the pO₂, the sO₂, and the hemoglobin
- 5th: Summarize whether it is a simple acidosis /alkalosis, mixed, and/or compensated.



Example 1

■ 7.40 / 40 / 90 / 25 / 1.2 / 95 / 15

■ 7.40 / 40 / 90 / 25 / 1.2 / 95 / 15

■ 7.40 / 40 / 90 / 25 / 1.2 / 95 / 15

■ 7.40 / 40 / 90 / 25 / 1.2 / 95 / 15

■ Normal!!



Example 2

- 7.25 / 40 / 60 / 19 / -7.5 / 80 / 10
- 7.25 / 40 / 60 / 19 / -7.5 / 80 / 10
- 7.25 / 40 / 60 / 19 / -7.5 / 80 / 10
- 7.25 / 40 / 60 / 19 / -7.5 / 80 / 10
- Metabolic Acidosis, uncompensated



Example 3

- 7.54 / 33 / 80 / 26 / 1.2 / 95 / 15
- 7.54 / 33 / 80 / 26 / 1.2 / 95 / 15
- 7.54 / 33 / 80 / 26 / 1.2 / 95 / 15
- 7.54 / 33 / 80 / 26 / 1.2 / 95 / 15
- Respiratory Alkalosis 2 hyperventilation

Ready to try some real life cases?





Real Examples 1 – P.H.

- 32 year old male with multiple admissions
- PMH: Poorly controlled diabetes, polysubstance abuse
- Exam: dry mucus membranes with fruity odor breath
- Labs: Anion gap 25, glucose 900



Real Examples 1 – P.H.

- 7.01 / 7 / 142 / 2 / -28.3 / 99 / 11.4
- Metabolic acidosis...
...with respiratory alkalosis compensation
- Given the patient's history, what is the cause of the metabolic acidosis?
- And of the respiratory compensation?
- Interventions: IVF, bicarb, insulin



Real Example 2 – E.K.

- 39 year old female with long history of alcohol abuse presents to the ER with epigastric pain
- Admitted for severe acute pancreatitis and received over 25 Liters of IVF in first 3 days of hospitalization
- The following ABG was done 3 weeks into hospitalization



Real Example 2 – E.K.

- 7.47 / 68 / 100 / 48 / 21.8 / 98 / 6.5
- Metabolic alkalosis...
... with respiratory acidosis compensation
- Given the patient's history, what is the cause of her alkalosis?
- And of the respiratory compensation?
- Treatment: gentle fluids, diamox



Real Example 3 – J.M.

- 58 year old female presented with chest and abdominal pain, intubated in the ER
 - Prolonged ICU course with multiple intubations and then tracheostomy
 - Ventilator dependent for most of her stay
- The following ABG done 2 months into hospitalization



Real Example 3 – J.M.

- 7 PM: 7.27 / 64 / 58 / 29 / 1.2 / 87 / 9.6
- 4 AM: 7.34 / 64 / 57 / 38 / 3.7 / 93 / 9.7
- Respiratory Acidosis, with subsequent compensation, probably from CO₂ narcosis
 - Interventions: Improve ventilation, increase Respiratory Rate, increase tidal volume
 - In non-vented patients, bipap or intubate



Conclusions

- When interpreting an ABG, obtain patient history and try to identify baseline status
- Break down the ABG into the various components, analyze, then put it back together with the patient's condition
- Identify causes and brainstorm interventions.



Internet Resources

- Online ABG tutorial:
<http://www.vectors.cx/paramedics/apps/abg.cgi>
- Up to Date online

